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Instrumentation in Support of Phytoplankton Experimentation (DURIP)

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LONG-TERM GOALS

My long-term goal is to understand the mechanisms responsible for the variability in phytoplankton abundance, optical properties, and rates of primary production. The ability to culture phytoplankton in a controlled environment and under specific environmental conditions improves my group's capability to study the time-dependent optical behavior of marine phytoplankton.

OBJECTIVES

The objective of this DURIP instrumentation grant is to establish a system for controlled phytoplankton experimentation in the laboratory. The system includes an autoclave to provide sterile culture media, free of bacteria and viruses, for growing phytoplankton in the laboratory and a computer-controlled interface that allows us to grow phytoplankton under controlled environmental conditions, sample them without compromising their axenic state, and measure their optical and physiological properties. The autoclave and computer controlled culture experimentation system had been the missing components in a suite of existing instrumentation that includes two new environmentally-controlled growth chambers, absorption and scattering sensors, fluorometers, particle counters, and radiometers.

APPROACH

In order to measure the optical properties of phytoplankton grown in cultures, it is essential that the culture media be bacteria- and virus-free. Otherwise, the inclusion of bacterial and/or viral particles would seriously compromise the validity of the optical measurements of phytoplankton. A large-capacity, steam-driven, high-pressure sterilizer for preparing bacteria- and virus-free phytoplankton growth media has been selected. This autoclave is capable of simultaneously sterilizing two 20-L carboys of seawater media, thus making it relatively ease to maintain large volumes of cultures. A computer-controlled culture unit will provide a method for diverting sub-samples of large phytoplankton cultures through existing flow-through optical instrumentation to measure absorption and scattering coefficients and fluorescence. These instruments were designed for ocean profiling applications but will be adapted to collect periodic measurements on sub-samples of culture. The sub-samples cannot be returned to the culture, to avoid contamination problems.

WORK COMPLETED

The purchase of the autoclave with its steam generator and the components for the computer controlled sampling system under the DURIP grant will be completed by December 2001, before the end of the grant period.

RESULTS

The autoclave is not yet installed, so we have no new results from growth experiments on phytoplankton cultures at this time.

IMPACT/APPLICATIONS

The addition of the autoclave and the computer-controlled sampling system to the phytoplankton culture facility at the Darling Marine Center will greatly my ONR-funded research on the time and irradiance-dependent variability of phytoplankton optical properties. We have found that cell-specific optical properties can change rapidly, on the time scale of less than a few hours. The proposed facility will allow us to understand the temporal dynamics of changes in optical properties and cell physiologies under controlled conditions. The Navy-relevant objectives for studying phytoplankton optics and associated physiologies is that an understanding of their variability is essential for extracting maximal information and making short-term predictions about water-column optics from satellite or aircraft hyperspectral remotely-sensed signals.

TRANSITIONS

This facility will also open new possibilities for research for other ONR-funded investigators at the Darling Marine Center, including Dr. Emmanuel Boss, Dr. Peter Jumars, Dr. Lawrence Mayer, and Dr. Mark Wells.

RELATED PROJECTS

This activity is directly related to and will enhance the research on "Time- and Irradiance-Dependent Behavior of the Quantum Yield of Chlorophyll *a* Fluorescence," Award Number N00014-00-1-0211 to the University of Maine, by providing the facilities to study phytoplankton optics and physiology under controlled environmental conditions.